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# HABITAT INVENTARIZATION, CHARACTERIZATION AND BIOINDICATION BY A "REPRESENTATIVE SPECTRUM OF ODONATA SPECIES (RSO)"

E. SCHMIDT
Seminar für Biologie und ihre Didaktik, Pädagogische Fakultät, Rheinische Friedrich--Wilhelms-Universität, Römerstrasse 164, D-5300 Bonn-1, Federal Republic of Germany

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A convenient working scheme for the rapid preparation of an evaluated inventory of the odonata species of a given habitat ("Representative Spectrum of Odonate Species" = RSO) is outlined. The evaluation is based on 5 verifiable status/abundance classes of the taxa recorded, which are assumed to represent a set of probability classes, verifiable under defined conditions. The RSO can also be used for the characterization of an individual habitat by its odonate fauna, and for bioindication of the habitat condition as required for conservation and adequate management.

## INTRODUCTION

This paper sums up experience of 25 years of field work concerned with the inventarization of Odonata habitats in limited time (e.g. SCHMIDT, 1979, 1980c, 1981a, 1981b, 1983c, 1984) The purpose of this work is three-fold:

— Opening the field records of Odonata to verification, and improving their correlation with the ecology and distribution patterns of the species, by separating accidental from verifiable records. Such a separation would improve the many current mapping schemes essentially.

— Securing inventories of the odonate fauna of breeding habitats that are sufficiently complete to show good correspondence between the known habitat preferences of the species found, and the ecofactors relevant to these species, as apparent from their status/abundance. Such a habitat characterization by its odonate fauna is a useful basis for conservation measures.

— Recognizing under- or over-representation of odonate species at a given habitat, resulting in habitat bioindication, especially pointing out possible anthropogenic influences on the habitat and its fauna, and providing suggestions for adequate habitat conservation and management (SCHMIDT, 1983c).

To this end a special working scheme has been developed, to be described below.

## THE PROBLEM OF ACCIDENTAL RECORDS

Accidental records should be eliminated. They may arise in various ways:

Odonata are very mobile insects, often migrating far from their typical breeding habitats (OLAFFSON, 1976). Temporary accumulation of mature imagines, which may lead to temporary breeding at other than the usual habitats, has been reported (SCHMIDT, 1974, 1980b). For statistical analyses of the correlation between probability-of-appearance and distance-to-next-breeding-place, and population density or migration cf. SCHMIDT (1967, 1980c). Unusual weather conditions during sensitive periods of the life cycle, or changes in the water level at the breeding place may also cause fluctuations in abundance (SCHMIDT, 1978).

In addition, accidental records may result from unsuitable recording conditions (during the wrong season, when odonates are represented by unsuitable stages like eggs or small larvae; at hours or under weather conditions where they are hidden and hard to find). Accidental records may also be caused by irregular working intensity or inexperience of the recorder, or by an unsuitable working scheme.

## IMPROVEMENT OF RECORDING METHODS

Our proposal for the improvement of recording methods is based on the following considerations:

(1) Conditions with the highest concentration of Odonata offer the best chance for their detection in the field. Recording should, therefore, be done under circumstances (season, hour, weather conditions) that fit the preferences of a species optimally. The following stages/activities need special attention: feeding period of ultimate larval instars; concentration of larvae near emergence sites; emergence, especially the stage with wings just unfolded but still "milky" and conspicuous; exuviae; the conspicuous maiden flight away from the water; the concentration of freshly emerged imagines at sunny places in the surroundings; concentration of adults at sexual or reproductive activities and, later in the day, while resting in the sun. When optimal recording conditions are selected and activities are observed by an experienced field worker, detection of every species present in sufficient numbers is

possible, allowing a satisfactory status determination valid for a particular working day, and open to verification.

(2) There usually is good correspondence between abundance of adults during sexual or reproductive activities, and abundance of larvae/frequency of emergence. Deviations from this rule may occur due to immigration or habitat damage caused by pollution of water or high fish predation (in both cases leading to over-representation of adults), — and at habitats that are too small or too much in the shadow (adults underrepresented; e.g. larger Anisoptera at isolated small ponds, or *Aeshna cyanea* at dark woodland ponds (SCHMIDT, 1983a).

Table I

Optimal recording periods for the different life history stages of species of the two phenological groups of CORBET (1983); — I, II, III: decades of the month, applicable to the Central European temperate climate zones in normal years

| Stage | *Sympecma* | Spring species | | Summer species | |
|---|---|---|---|---|---|
| | | early | late | normal | late |
| Last instar larvae | July I | April | May I | June | July |
| Emergence, exuviae, tenerals | July II | May I | May III-<br>-June I | June II-<br>-July I | July III-<br>-August I |
| Mature imagines, sexual and reproductive activities | April | May II-<br>-June I<br>(-June II) | June III-<br>-July II | July II-<br>-August I | September<br>(October I) |

(3) Species breeding regularly and in sufficient numbers are the only reliable basis for habitat inventory, characterization and bioindication. Under recording conditions known to be optimal for the imaginal as well as the larval stage and for emergence, these species should be found every year without exception. Covering the seasons during 2-3 years with a minimum set of 3-5 recording days at optimal conditions for every stage and species group (Tabs I-II) will eliminate records of species irregularly present, or present in negligeably small numbers.

(4) A quantification of the field records is necessary to make comparisons possible. Even when marking methods are used for the determination of population size, the high mobility of adult odonates poses serious problems (SCHMIDT 1964a, KAISER, 1984). For the present purpose we can restrict ourselves to estimating the numbers of mature specimens visible under the optimal conditions described above. The numbers thus determined are usually lower than those found in marking experiments, but may be regarded as a suitable measure of the occupation of the sites preferred, and of the habitat in

Table II

Some examples of the phenological groups in Table I; no species are mentioned that belong to two or more phenological groups and that are, therefore, less problematic for recording

| | |
|---|---|
| Early spring species | *Coenagrion armatum, C. lunulatum, Leucorrhinia rubicunda; Pyrrhosoma nymphula, (Erythromma najas)* |
| Late spring species | *Orthetrum cancellatum, Somatochlora metallica* |
| Early summer species | *Lestes dryas* |
| Normal summer species | *Lestes sponsa, Sympetrum danae, S. vulgatum, Aeshna cyanea, A. grandis* |
| Late summer species | *Lestes viridis, Aeshna mixta, Sympetrum striolatum* |

general, under optimal conditions. Reference figure should be the average of seasonal maxima, reduced to a system of 2-3 abundance classes (high/low, or high/moderate/low), to eliminate yearly fluctuations and estimation errors.

(5) The following status/abundance classes are proposed (SCHMIDT 1979, 1981b, 1982a, 1983a, 1983c):
- Species breeding regularly in sufficient numbers:
  - (a) with high abundance
  - (b) with intermediate abundance
  - (c) with low abundance
- Species breeding irregularly or in insufficient numbers (accidental records even under optimal conditions):
  - (d) with high frequency, or only temporarily high abundance (frequent guests, temporarily breeding species breeding regularly but in negligeable numbers)
  - (e) with low frequency (rare guests)

Definition: The inventory of the odonate species of a habitat, evaluated by the status classes (a-e) is defined here as the "Representative Spectrum of Odonate Species" (RSO) of that habitat.

(6) The objectivity and reproducibility of a particular RSO can easily be proven by random checks of the habitat in question. The Spectrum indicates the probability of encountering species under defined conditions. Every species classified as a regular breeder must be met with in adequate numbers under fitting conditions, and no other species is supposed to breed regularly, unless the habitat should have changed. The RSO is open to confirmation on other recording days, which should not change the results (apart from occasional migrants), and it is open to verification by other observers.

(7) Although this working scheme is designed for the study of established habitats with a stable odonate fauna, it can also be used in unstable habitats (e.g. water bodies with level fluctuations, or habitats in the pioneer phase). Here

temporary breeding and changes in the odonate fauna are essential characteristics pointing at changes in habitat ecology. Verification here is possible only by comparison with other habitats under similar conditions.

(8) In all cases, species identification should be confirmed by preserved specimens or macrophotography of imagines (SCHMIDT, 1982c) if possible accompanied by documentation of behaviour and site preference, and by collection of exuviae or preserved larvae.

## CHARACTERIZATION OF INDIVIDUAL HABITATS BY RSO

For the characterization of a habitat by its RSO we need additional information on its ecological features that are of importance to odonates. Description of the habitat and its vegetation structure can be profitably supplemented by photodocumentation. The chemistry and physics of the water should be covered by the usual limnological parameters (cf. MACAN, 1966; SCHWOERBEL, 1980).

A "second dimension" must be added to the RSO by stating the habitat preferences of the species encountered. The extent to which this should be done depends on the specific situation (cf. SCHMIDT, 1964a, 1967, 1971, 1972, 1980a, 1983a, 1983b).

The set of habitat preferences, included in the RSO, should correspond with the set of ecological factors of the habitat in as far as of importance for the species concerned.

In this way the best characterization of the habitat is obtained, at the minimum level of investigation; it is more informative than any statement based on selected species only, or on a cenosis classification (SCHMIDT, 1982e).

## BIOINDICATION OF HABITATS BASED ON RSO

Especially when the habitat is damaged by man, bioindication may be of importance. Such damage usually first causes a decrease in abundance and in status, followed then by disappearance of certain species. Some species, by their habitat preferences, are more susceptible to specific types of damage than others and will be first to be affected; some types of damage, as e.g. reduction of bank vegetation, may temporarily favour certain species (e.g. *Orthetrum cancellatum*). Thus, there will be specific changes in RSO due to specific type of habitat damage.

In order to monitor changes in the habitat, we must compare the habitat characterization based on the RSO with the expected RSO of an intact habitat of the same type in the same region (or in a different region, making allowance for biogeographical differences). Such a comparison gives a detailed indication of the damage, on which advices for habitat conservation or management can be based

(SCHMIDT, 1983c). For confirmation, cases of controlled habitat change with effects on odonate fauna should be used (CLAUSNITZER, 1983; SCHMIDT, 1967, 1972, 1975, 1982b).

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